

A Probabilistic Technique for Improving the Mid-Swath Wind Direction Accuracy of Scanning Pencil Beam Scatterometers

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Abstract

scatterometry

The SeaWinds on QuikSCAT scatterometer is a device developed by NASA JPL to measure the speed and direction of ocean surface winds. Simulations performed in order to determine the expected performance of the instrument prior to its launch have indicated that the accuracy of the retrieved wind vectors varies across the swath. In particular the mid-swath accuracy is worse than that of the rest of the swath. This behavior is a general characteristic of scanning pencil beam scatterometers. For SeaWinds, the accuracy of the rest of the swath, and the size of the swath are such that the instrument meets its science requirements despite mid-swath shortcomings. However, by understanding the problem at mid-swath, we can improve the performance there as well, yielding even better coverage and accuracy than was originally intended. The mid-swath performance degradation is due to suboptimal viewing geometry. In particular mid-swath measurements contains measurements from two azimuths, roughly 180 degrees apart. With the standard wind retrieval technique, mid-swath root mean square (RMS) wind direction errors are approximately 30 degrees for low wind speeds (3 - 5.5 m/s) and 20 degrees for moderate to high wind speeds (5.5 - 30 m/s). We discuss the underlying causes of this phenomenon in detail and propose a modification to the wind retrieval technique in order to improve mid-swath performance. By estimating the range of likely wind directions for each measurement cell, one can optimally apply information from neighboring cells in order to reduce random wind direction errors without significantly degrading the resolution of the resultant wind field. In this manner we are able to achieve mid-swath RMS wind direction errors as low as 15 degrees for low winds and 10 degrees for moderate to high winds, while at the same time preserving high resolution structures such as cyclones and fronts. Since our results are based on simulated data, we also outline a procedure for making ^{use} ~~using~~ of real data to optimize the technique after launch.